PROCESS TO MAKE DECISION ON WHEN TO ALTER UPSTREAM BURST PROFILE
BASED UPON PACKET LOSS PERCENTAGE USING HYSTERESIS THRESHOLDS
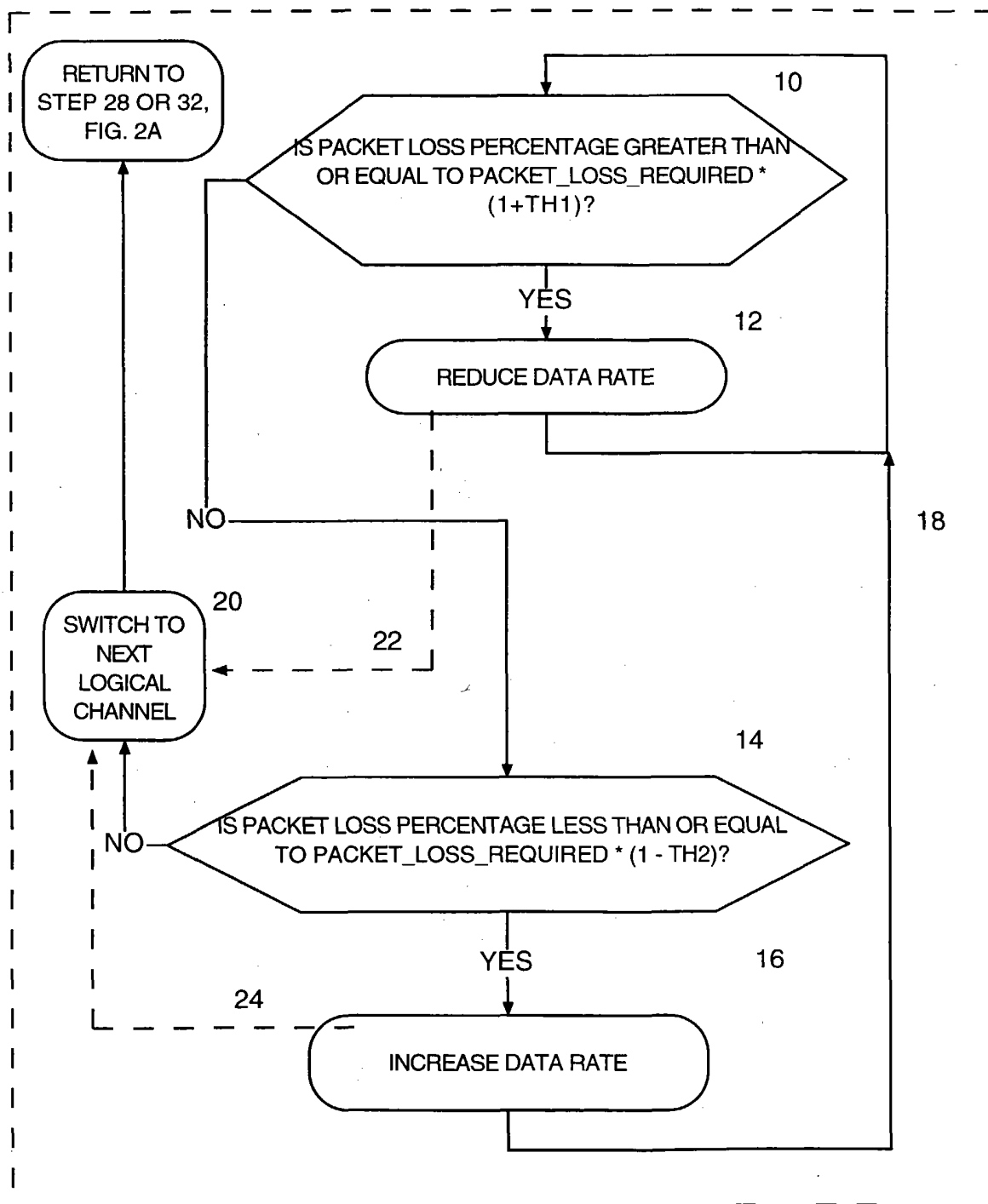
RETURN TO
STEP 28 OR 32,
FIG. 2A

IS PACKET LOSS PERCENTAGE GREATER THAN
OR EQUAL TO PACKET_LOSS_REQUIRED *
(1+TH1)?

10

YES

12

REDUCE DATA RATE

NO

18

SWITCH TO
NEXT
LOGICAL
CHANNEL

20

22

14

IS PACKET LOSS PERCENTAGE LESS THAN OR EQUAL
TO PACKET_LOSS_REQUIRED * (1 - TH2)?

NO

YES

16

24

INCREASE DATA RATE
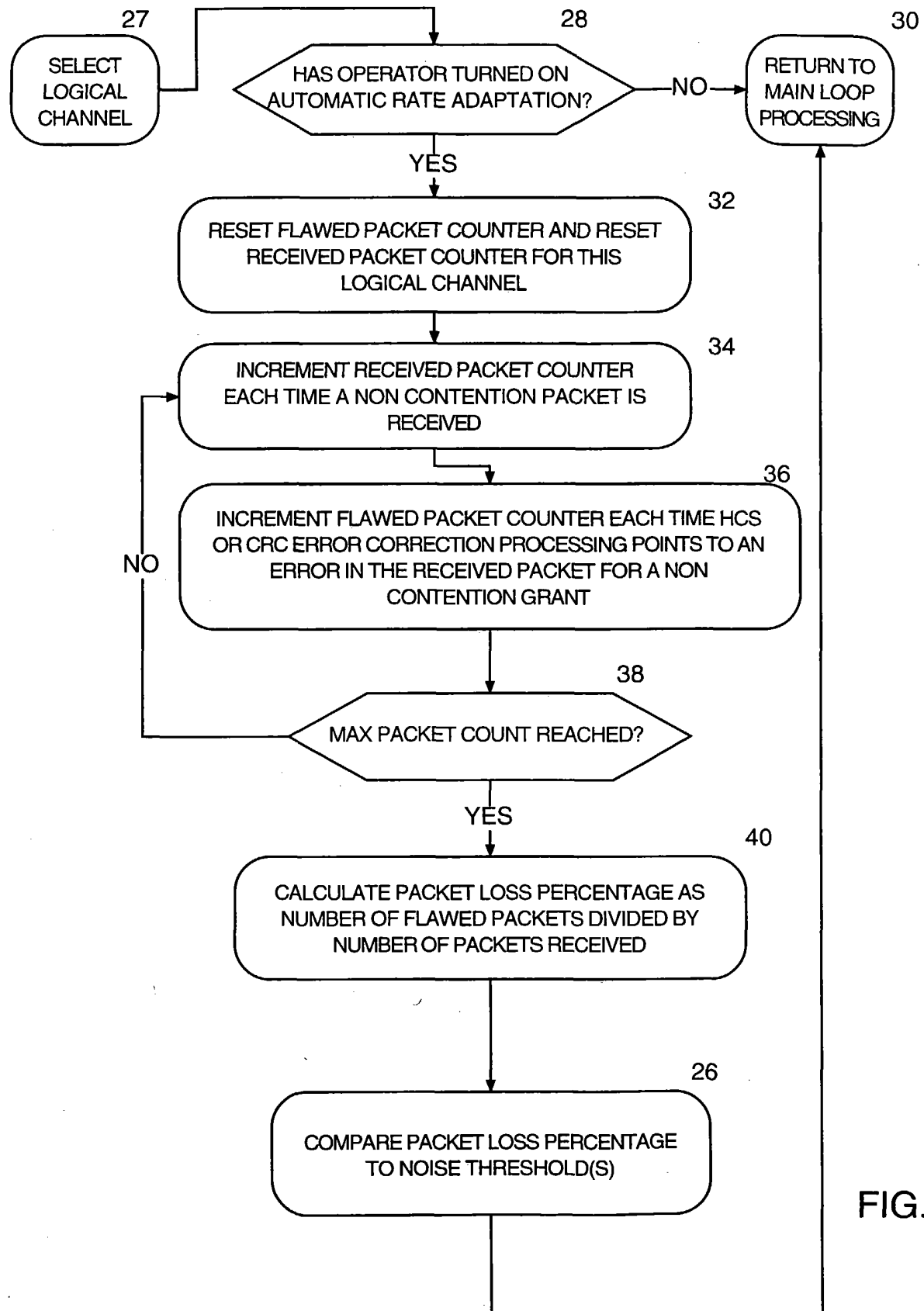
FIG. 1

CMTS PROCESSING FOR AUTOMATIC RATE ADAPTATION WITH CHANGING NOISE

```
   ┌──────────┐
   │  SELECT  │  27
   │ LOGICAL  │
   │ CHANNEL  │
   └──────────┘
```

28 ── HAS OPERATOR TURNED ON AUTOMATIC RATE ADAPTATION? ── NO ──▶ RETURN TO MAIN LOOP PROCESSING 30

YES

RESET FLAWED PACKET COUNTER AND RESET RECEIVED PACKET COUNTER FOR THIS LOGICAL CHANNEL 32

INCREMENT RECEIVED PACKET COUNTER EACH TIME A NON CONTENTION PACKET IS RECEIVED 34

INCREMENT FLAWED PACKET COUNTER EACH TIME HCS OR CRC ERROR CORRECTION PROCESSING POINTS TO AN ERROR IN THE RECEIVED PACKET FOR A NON CONTENTION GRANT 36

MAX PACKET COUNT REACHED? 38

NO

YES

CALCULATE PACKET LOSS PERCENTAGE AS NUMBER OF FLAWED PACKETS DIVIDED BY NUMBER OF PACKETS RECEIVED 40

COMPARE PACKET LOSS PERCENTAGE TO NOISE THRESHOLD(S) 26

FIG. 2A

42

CHANGE IN DATA RATE REQUIRED?

YES

44

SEND MESSAGE TO
APPROPRIATE PROCESS TO
CHANGE DATA RATE

46

SELECT BURST PROFILE FROM TABLE FOR NEXT
DATA RATE UP OR NEXT DATA RATE DOWN, AS
APPROPRIATE, GENERATE NEW UCD MESSAGE FOR
THE LOGICAL CHANNEL AND TRANSMIT, OR DISPLAY
ALERT TO CABLE OPERATOR SUGGESTING DATA RATE
CHANGE

FIG. 2B

CMTS PROCESSING FOR AUTOMATIC RATE ADAPTATION WITH CHANGING NOISE

70

START

RETURN TO
MAIN LOOP
PROCESSING

50

RESET SIGNAL-TO-NOISE CALCULATION
MECHANISM FOR THIS LOGICAL CHANNEL

52

INCREMENT RECEIVED PACKET COUNTER EACH TIME
A NON CONTENTION PACKET IS RECEIVED SO AS TO
ENABLE DETERMINATION OF A WINDOW OVER
WHICH AVERAGE SNR WILL BE CALCULATED

54

NO

CALCULATE RUNNING AVERAGE_NOISE OF
CHANNEL BASED UPON BURST_NOISE

56

MAX PACKET COUNT REACHED?

YES

58

CALCULATE AVERAGE SIGNAL-TO-NOISE
RATIO OF CHANNEL

60

COMPARE SNR OF LOGICAL CHANNEL TO
SNR NOISE THRESHOLD(S)

FIG. 3A

```
                                                          62

              CHANGE IN DATA RATE REQUIRED?

                                                                    68
                        YES
                                            64

                   SEND MESSAGE TO
                APPROPRIATE PROCESS TO
                   CHANGE DATA RATE

                                                          66

           SELECT BURST PROFILE FROM TABLE FOR NEXT
            DATA RATE UP OR NEXT DATA RATE DOWN, AS
           APPROPRIATE, GENERATE NEW UCD MESSAGE FOR
           THE LOGICAL CHANNEL AND TRANSMIT, OR DISPLAY
           ALERT TO CABLE OPERATOR SUGGESTING DATA RATE
                          CHANGE
```

FIG. 3B

92

RETURN TO
MAIN LOOP
PROCESSING

72

START

74

RESET TOTAL FLAWED CODEWORD
COUNTER/ACCUMULATOR TO ZERO AND RESET
RECEIVED TOTAL RECEIVED CODEWORD
COUNTER TO ZERO FOR THIS LOGICAL
CHANNEL

76

ADD NUMBER OF CODEWORDS RECEIVED IN A
BURST TO RUNNING TOTAL OF RECEIVED
CODEWORDS EACH TIME A PACKET IS
RECEIVED

78

ADD NUMBER OF CODEWORDS WITH
UNCORRECTABLE ERRORS REPORTED BY THE R-S
DECODER FOR THE RECEIVED BURST TO THE
RUNNING TOTAL OF FLAWED CODEWORDS FOR THIS
LOGICAL CHANNEL AND THE PERTINENT INTERVAL

NO

80

MAX COUNT REACHED?

YES

82

DETERMINE THE BIT ERROR RATE OR BYTE
ERROR RATE OF THE LOGICAL CHANNEL BEING
PROCESSED

84

COMPARE BIT ERROR RATE OR BYTE
ERROR RATE OF LOGICAL CHANNEL TO
APPROPRIATE THRESHOLD(S)

FIG. 4A

86

CHANGE IN DATA RATE REQUIRED?

YES

88

SEND MESSAGE TO
APPROPRIATE PROCESS TO
CHANGE DATA RATE

90

SELECT BURST PROFILE FROM TABLE FOR NEXT
DATA RATE UP OR NEXT DATA RATE DOWN, AS
APPROPRIATE, GENERATE NEW UCD MESSAGE FOR
THE LOGICAL CHANNEL AND TRANSMIT, OR DISPLAY
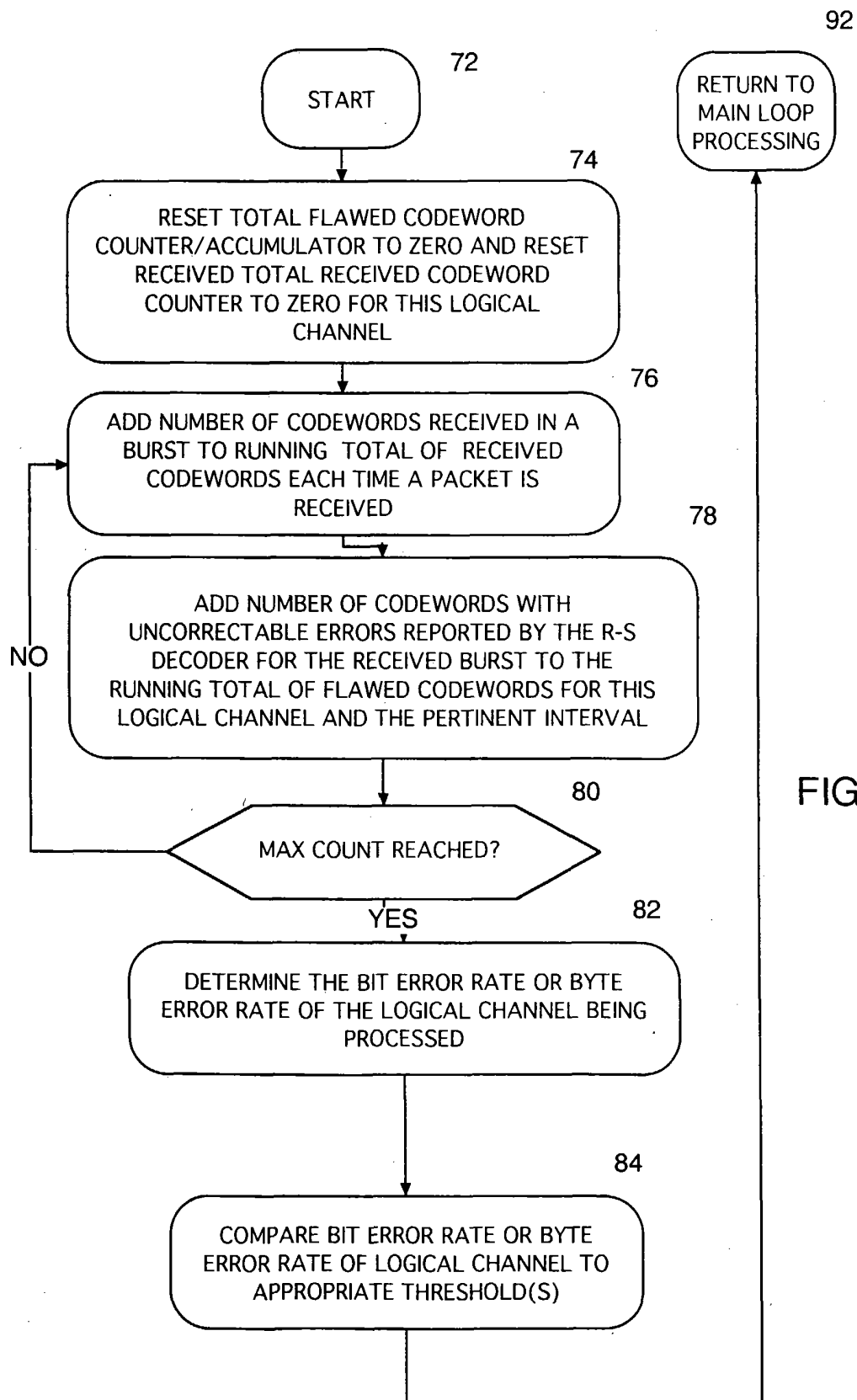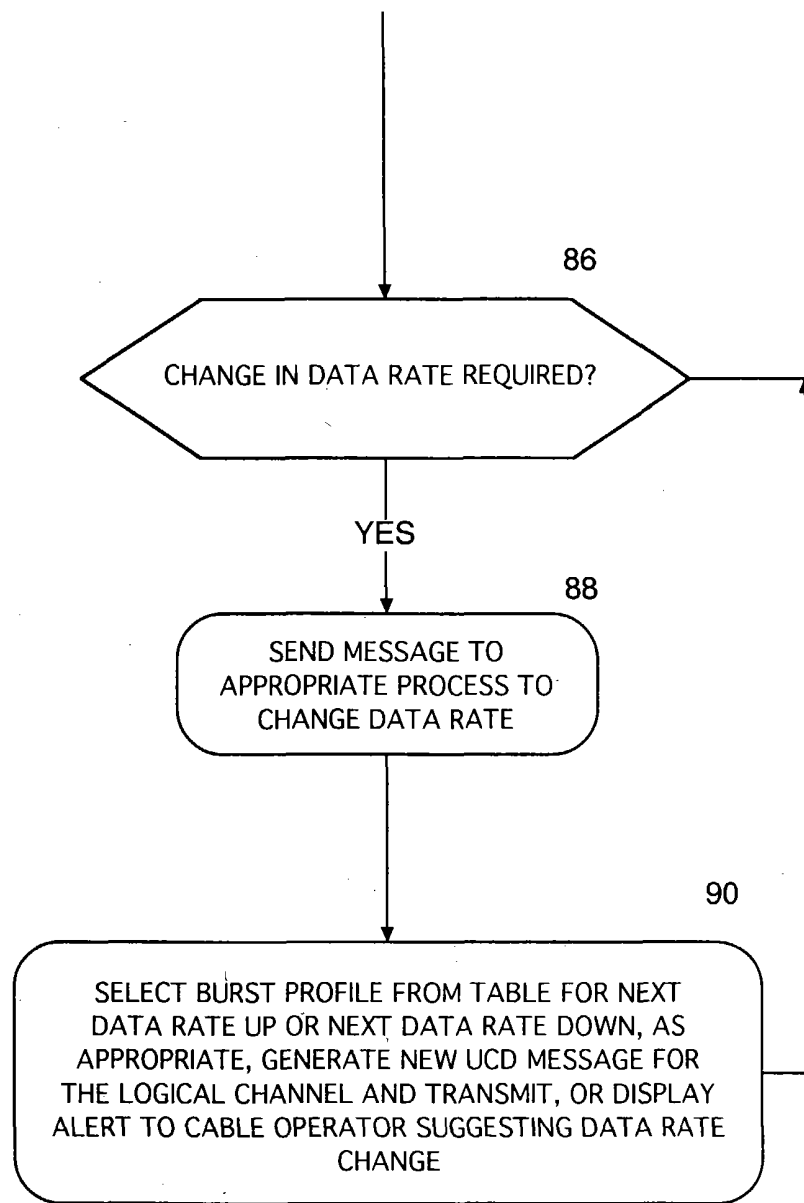ALERT TO CABLE OPERATOR SUGGESTING DATA RATE
CHANGE

FIG. 4B

GENERIC PROCESS TO AUTOMATICALLY DETECT THE NEED TO ADAPT BIT RATE
TO NOISE CONDITIONS ON A LOGICAL CHANNEL AND AUTOMATICALLY CHANGE
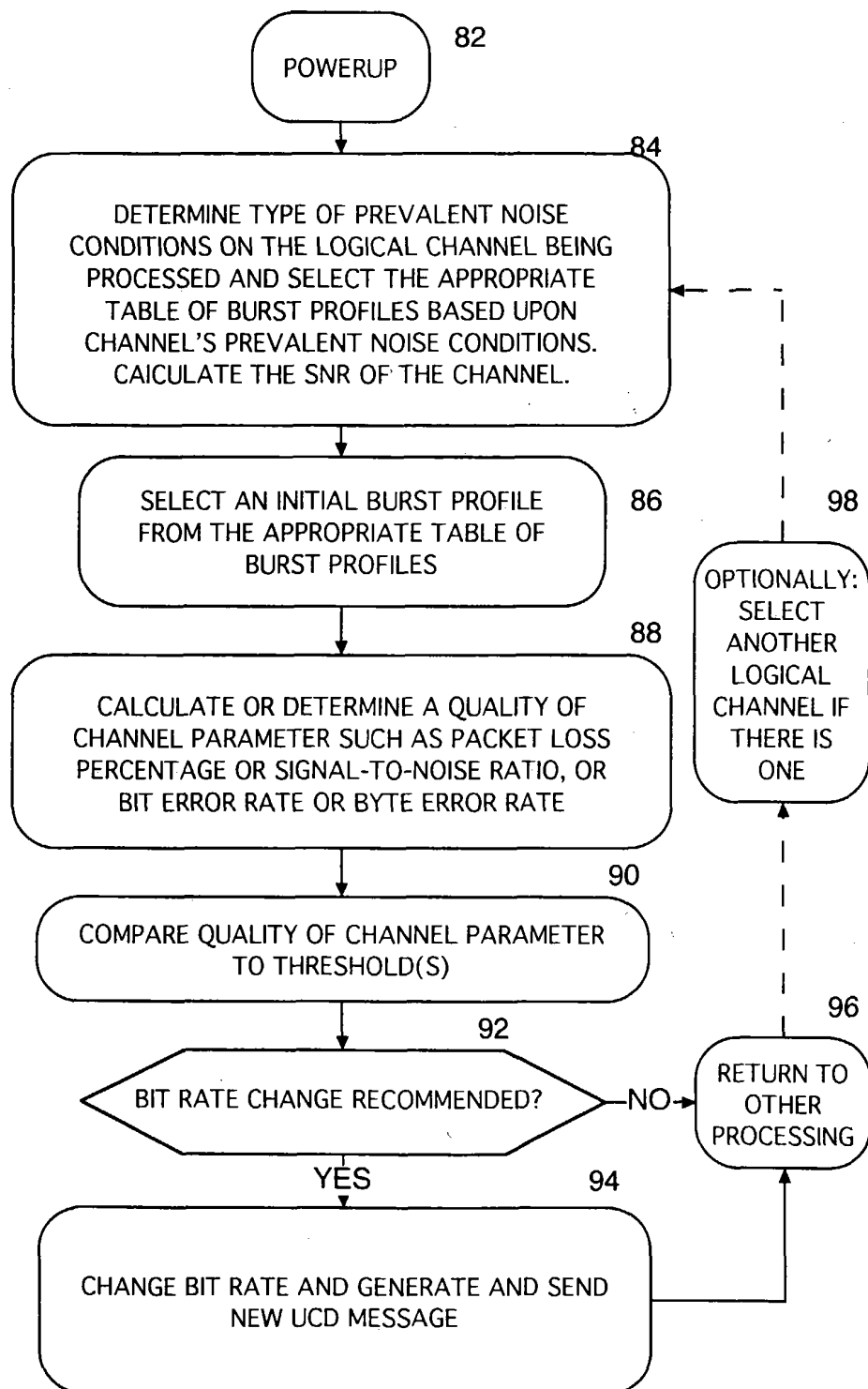BIT RATE

82

POWERUP

84

DETERMINE TYPE OF PREVALENT NOISE
CONDITIONS ON THE LOGICAL CHANNEL BEING
PROCESSED AND SELECT THE APPROPRIATE
TABLE OF BURST PROFILES BASED UPON
CHANNEL'S PREVALENT NOISE CONDITIONS.
CAICULATE THE SNR OF THE CHANNEL.

SELECT AN INITIAL BURST PROFILE   86
FROM THE APPROPRIATE TABLE OF
BURST PROFILES

88

CALCULATE OR DETERMINE A QUALITY OF
CHANNEL PARAMETER SUCH AS PACKET LOSS
PERCENTAGE OR SIGNAL-TO-NOISE RATIO, OR
BIT ERROR RATE OR BYTE ERROR RATE

90

COMPARE QUALITY OF CHANNEL PARAMETER
TO THRESHOLD(S)

92

BIT RATE CHANGE RECOMMENDED?   —NO→

YES   94

CHANGE BIT RATE AND GENERATE AND SEND
NEW UCD MESSAGE

98

OPTIONALLY:
SELECT
ANOTHER
LOGICAL
CHANNEL IF
THERE IS
ONE

96

RETURN TO
OTHER
PROCESSING

FIG. 5

GENERIC PROCESS TO AUTOMATICALLY DETECT THE NEED TO ADAPT BIT RATE TO NOISE CONDITIONS ON A LOGICAL CHANNEL AND GENERATE MESSAGE

82
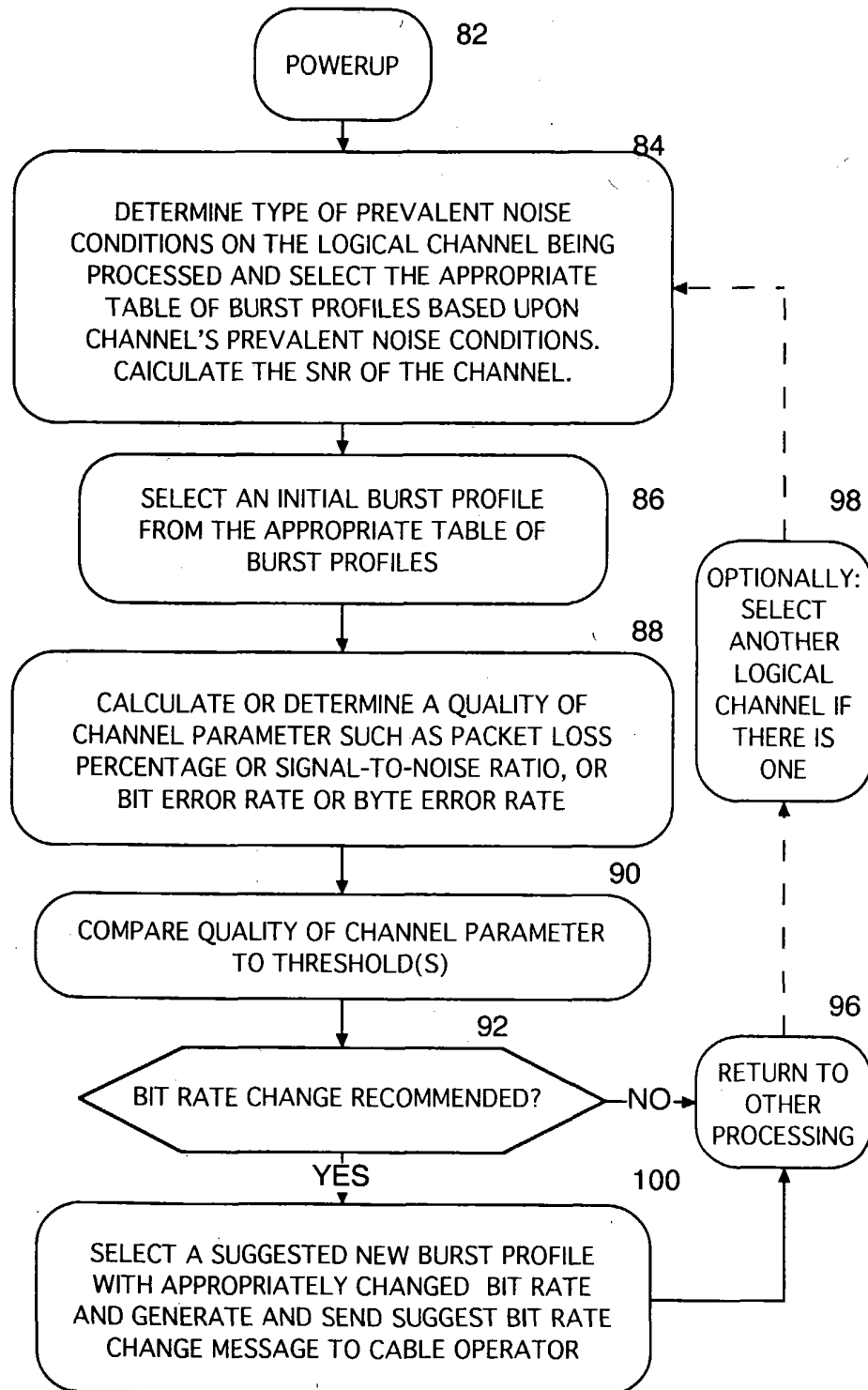POWERUP

84
DETERMINE TYPE OF PREVALENT NOISE CONDITIONS ON THE LOGICAL CHANNEL BEING PROCESSED AND SELECT THE APPROPRIATE TABLE OF BURST PROFILES BASED UPON CHANNEL'S PREVALENT NOISE CONDITIONS. CAICULATE THE SNR OF THE CHANNEL.

86
SELECT AN INITIAL BURST PROFILE FROM THE APPROPRIATE TABLE OF BURST PROFILES

98
OPTIONALLY: SELECT ANOTHER LOGICAL CHANNEL IF THERE IS ONE

88
CALCULATE OR DETERMINE A QUALITY OF CHANNEL PARAMETER SUCH AS PACKET LOSS PERCENTAGE OR SIGNAL-TO-NOISE RATIO, OR BIT ERROR RATE OR BYTE ERROR RATE

90
COMPARE QUALITY OF CHANNEL PARAMETER TO THRESHOLD(S)

92
BIT RATE CHANGE RECOMMENDED? —NO→

96
RETURN TO OTHER PROCESSING

YES

100
SELECT A SUGGESTED NEW BURST PROFILE WITH APPROPRIATELY CHANGED BIT RATE AND GENERATE AND SEND SUGGEST BIT RATE CHANGE MESSAGE TO CABLE OPERATOR

FIG. 6

Example f burst profiles of data for different AWGN SNR for DOCSIS 1.x

#	Use for Impulse Noise Channel Yes/No	% Bit Rate From Max	Net Data Rate @ 2.56 Msps	Modulation		RS		
1	y	22%	2.3 Mbps	QPSK		k=16, t=10		
2	y	29%	3.0 Mbps	QPSK		k=28, t=10		
			3.8 Mbps	QPSK		k=58, t=10		
3	y	39%	4.0 Mbps	QPSK		k=78, t=10		
4	n	46%	4.7 Mbps	QPSK		k=235, t=10		
5	y	50%	5.1 Mbps	16-QAM		k=20, t=10		
			6.0 Mbps	16-QAM		k=28, t=10		
6	y	62%	6.4 Mbps	16-QAM		k=39, t=10		
			7.5 Mbps	16-QAM		k=55, t=10		
7	y	79%	8.1 Mbps	16-QAM		k=78, t=10		
8	y	92%	9.4 Mbps	16-QAM		k=235, t=10		
9	n	100%	10.24 Mbps	16-QAM		k=16, t=0		

FIG. 7

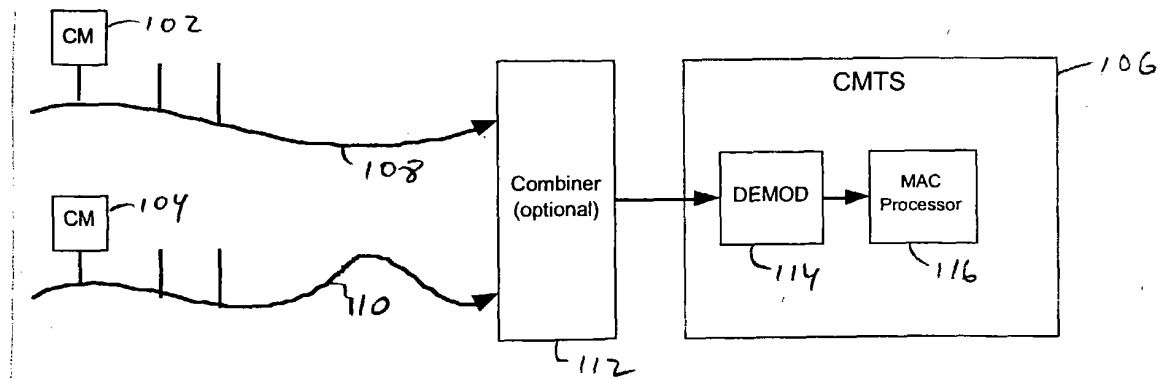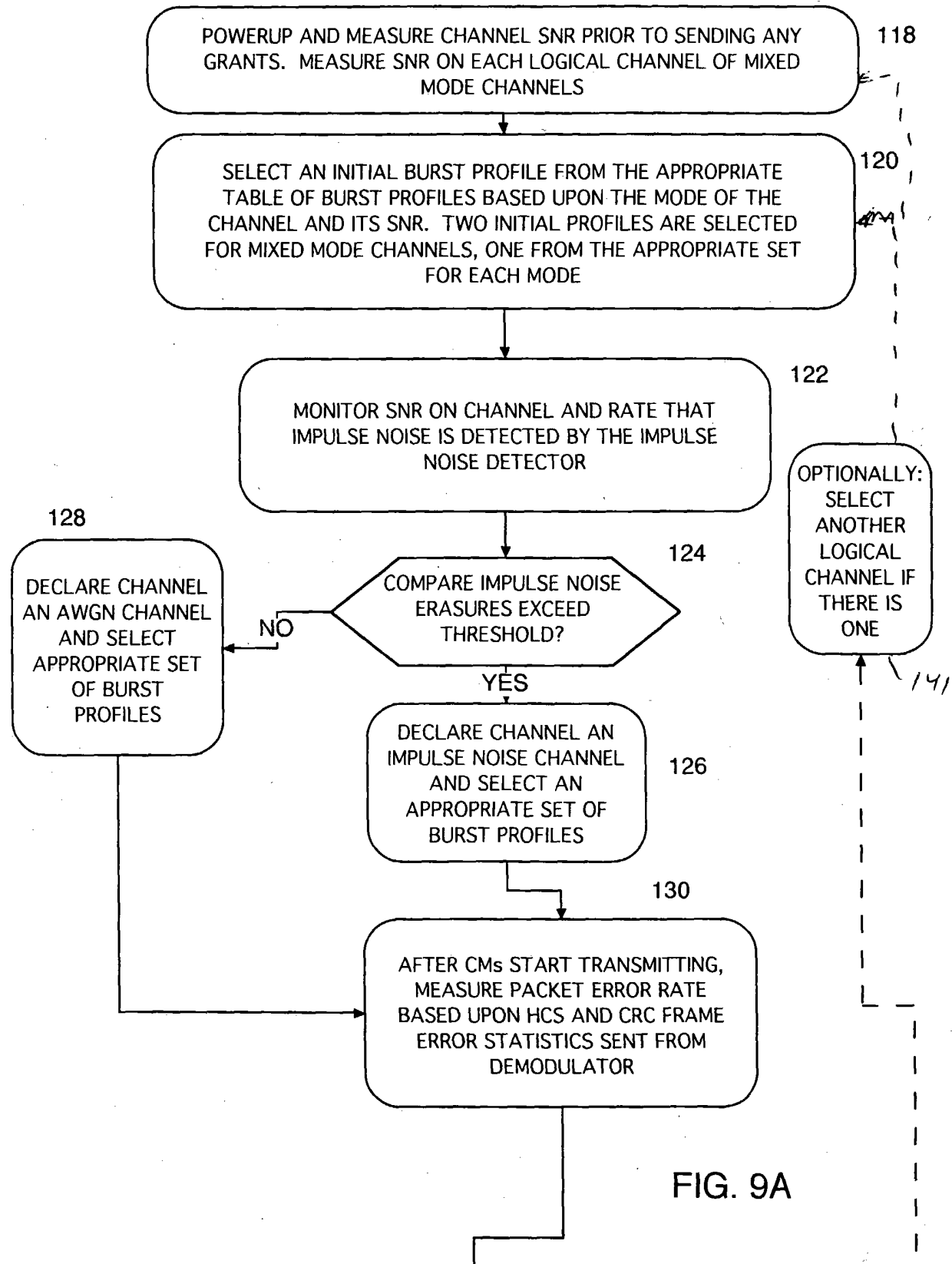
FIG. 8

GENERIC PROCESS TO AUTOMATICALLY DETECT THE NEED TO ADAPT BIT RATE
TO NOISE CONDITIONS ON A LOGICAL CHANNEL AND ADJUST THE BIT RATE

POWERUP AND MEASURE CHANNEL SNR PRIOR TO SENDING ANY
GRANTS. MEASURE SNR ON EACH LOGICAL CHANNEL OF MIXED
MODE CHANNELS

118

SELECT AN INITIAL BURST PROFILE FROM THE APPROPRIATE
TABLE OF BURST PROFILES BASED UPON THE MODE OF THE
CHANNEL AND ITS SNR. TWO INITIAL PROFILES ARE SELECTED
FOR MIXED MODE CHANNELS, ONE FROM THE APPROPRIATE SET
FOR EACH MODE

120

MONITOR SNR ON CHANNEL AND RATE THAT
IMPULSE NOISE IS DETECTED BY THE IMPULSE
NOISE DETECTOR

122

128

DECLARE CHANNEL
AN AWGN CHANNEL
AND SELECT
APPROPRIATE SET
OF BURST
PROFILES

COMPARE IMPULSE NOISE
ERASURES EXCEED
THRESHOLD?

124

NO

YES

OPTIONALLY:
SELECT
ANOTHER
LOGICAL
CHANNEL IF
THERE IS
ONE

DECLARE CHANNEL AN
IMPULSE NOISE CHANNEL
AND SELECT AN
APPROPRIATE SET OF
BURST PROFILES

126

130

AFTER CMs START TRANSMITTING,
MEASURE PACKET ERROR RATE
BASED UPON HCS AND CRC FRAME
ERROR STATISTICS SENT FROM
DEMODULATOR

FIG. 9A

132

BIT RATE CHANGE RECOMMENDED? ——NO——→ RETURN TO OTHER PROCESSING

139

YES

134

PICK A NEW BURST PROFILE WITH A PROPERLY SELECTED BIT RATE TO MAINTAIN THE PACKET ERROR RATE WITHIN A PACKET ERROR RATE REQUIREMENT, AND GENERATE AND SEND A NEW UCD MESSAGE FOR THE NEW BURST PROFILE

REPEAT PER MONITORING PROCESS DESCRIBED ABOVE STARTING WITH STEP 122

136 *SUCCESS*

137

NO

HAVE PREDETERMINED NUMBER OF CYCLES THROUGH THE MONITORING PROCESS BEEN COMPLETED WITHOUT BRINGING THE PER WITHIN THE DESIRED PER REQUIREMENT?

138

JUMP TO ANOTHER LOGICAL CHANNEL BY SENDING NEW MAP AND UCD MESSAGES TO CMS

140

FIG. 9B